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# OCCURENCE AND AETIOLOGY OF ACUTE RESPIRATORY DISEASES: RESULTS OF A LONGTERM SURVEILLANCE PROGRAMME

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*Summary.* — Totals of 58,661,000 acute respiratory disease (ARD) cases, 1,376,651 bronchitis and pneumonia complications, and 93,042 deaths from influenza, bronchitis, pneumonia or chronic pulmonary affection were notified during 11 years of ARD surveillance from 1975 to 1986. All ARD seasons started with the first phase in September-December; this increase in morbidity was caused chiefly by adenoviruses, parainfluenza viruses, rhinoviruses and *M. pneumoniae*. Second wave of ARD morbidity occurring in January-April used to be explosive and was associated with an influenza epidemic in 9 of the 11 seasons; only in 1978/79 and 1984/85 the ARD epidemics were caused by adenoviruses and especially RSV, the share of influenza being minimal. Pneumonia and bronchitis excesses occured during epidemics caused by *M. pneumoniae* in 1975/76, 1980/81 and 1985/86. Particularly high mortality excesses occurred in 1976, 1977 and 1983 during epidemics elicited by a new drift variants of influenza A(H3N2). Identification of viral agent or *M. pneumoniae* attempted in 5474 ARD cases was successful at 37.4 %. The respective contributions of parainfluenza viruses, adenoviruses, influenza A virus and RSV to overall aetiologically identified morbidity were 14.2, 13.9, 13.8, and 12.0 %. Mixed infections (2—3 agents identified simultaneously) accounted for 14.6 % of cases. Type B influenza virus, rhinoviruses, enteroviruses and herpes simplex virus contributed only by 5.6—7.8 %. In ordinary seasons the share of *M. pneumoniae* in aetiologically identified ARD morbidity was 0.6—3.8 %; this agent displayed predominance at 5-year cycles, when accounting for 20.5—38.9 % of cases. The most frequently detected agents in individual age groups were as follows: in preschool children parainfluenza (18.6 %), RSV (16.6 %), and adenoviruses (17.4 %); in school children *M. pneumoniae* (26 %), influenza A and B (10.2 and 14.7 % respectively), and adenoviruses (10.7 %); in adolescents and young adults influenza type A (20.2 %), *M. pneumoniae* (15.0 %), and rhino-

viruses (13.3 %); in adults above 25 years age influenza A virus (38 %), and other respiratory viruses at a frequency lower than 10 % each.

*Key words*: *acute respiratory disease*; *influenza virus*; *respiratory viral agents*; *Mycoplasma pneumoniae*

## *Introduction*

Acute respiratory diseases (ARD) belong to the most frequently notified infectious complaints in Czechoslovakia. They are the most frequent cause of absence from work and school from September to June resulting in economic losses, and the second most frequent cause of death (Syrůček *et al.*, 1985). An innovated ARD surveillance programme was launched in 1969 with the object to elucidate the regularities of ARD incidence and of the interrelations among different viruses and *Mycoplasma pneumoniae* as agents of ARD, and eventually, to get these diseases under control (Syrůček *et al.*, 1981). This paper presents the results of this programme obtained during the last 11-year period in continuation of our findings reported previously (Strnad *et al.*, 1976).

## *Materials and Methods*

*The ARD epidemiological surveillance programme.* Collection of data on morbidity and complications in age groups of 0—5, 6—14, and 15+ years was based on regular weekly notification from 75 districts of the Czech provinces (ČSR — Bohemia, Moravia, and capital city of Prague). The only ARD complications notified were bronchitis and pneumonia. Data on death from influenza (487), pneumonia (480—486), bronchitis (466), and chronic pulmonary affections (490—493) were obtained monthly from the Czech Statistical Bureau files. Complications and deaths were stated in absolute numbers, incidence per 100,000 populations per year separately for each age group (Syrůček, 1981).

*Virological surveillance.* Regular virological surveillance was carried out in Prague. Swabs were collected daily, serum samples when appropriate, from ARD cases in 7 to 10 health facilities covering all age groups. Every year this sample collection programme started in September and continued through June. After this, sampling was conducted according to the epidemiological situation depending entirely on reports of ARD cases particularly from preschool and school facilities, paediatric clinics, etc.

*Virus isolations* (influenza, parainfluenza, respiratory syncytial virus (RSV), adeno-, rhino-, and enteroviruses, herpes simplex as well as *Mycoplasma pneumoniae*) were performed from nasal and pharyngeal swabs collected into 5 ml sampling medium (Veal Infusion Broth Difco plus 0.5 % bovine serum albumin and antibiotics) and then cultivated on the usual cell lines, L-132, HEp-2, LEP (human embryo lung diploid cells), Madin Darby canine kidney (MDCK), *Macacus rhesus* or *Cynomolgus aethiops* secondary kidney cultures, and on chicken embryos. For *Mycoplasma pneumoniae* isolation, swabs taken from the same patients were immersed into 3 ml Difco PPLO broth containing 0.5 % bovine serum albumin and cultivation was performed on solid Difco PPLO agar with 20 % horse serum, 10 % yeast extract, and 2.5 % thalium acetate 1 : 50.

The methods used for agent isolation and identification and for serological testing of paired sera were those recommended by WHO (Palmer *et al.*, 1975; Lennette and Schmidt, 1979).

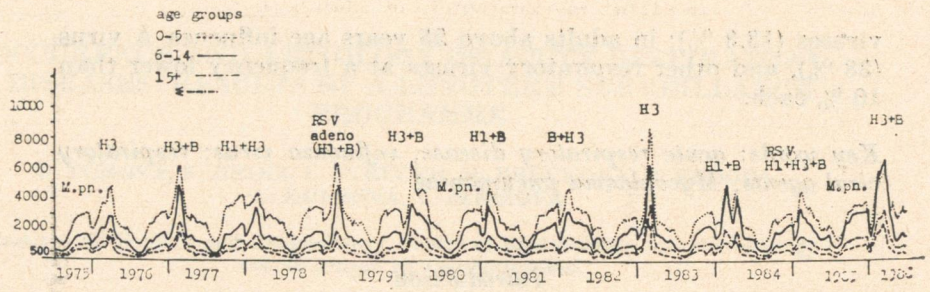


**Fig. 1.**

ARD morbidity in ČSR, 1975—1986
Explanations: Morbidity is expressed per 100.00 population of individual age groups (0—5, 6—14, > 15 years) for each calendar week. The abbreviations M. pn. (*Mycoplasma pneumoniae*), H1, H3, B (influenza type A(H1N1), A(H3N2), and B), RSV (respiratory syncytial virus), adeno (adenovirus) indicate the predominant agent in the individual seasons.

## *Results*

### *Epidemiological analysis of ARD in 1975—1986*

Figure 1 gives a survey of ARD incidence during the 11-year period in the age groups of preschool children (0—5 years), school children (6—14 years), and adolescents and adults (15+ years). Figure 2 shows, for the same period, the occurrence of complications, i.e., the absolute numbers of pneumonia and bronchitis cases, while Figure 3 presents the numbers of deaths from influenza, bronchitis, pneumonia, and chronic pulmonary affections.

The figures notified during the period concerned were 58,661,000 ARD cases, 1,271,231 complications, and 85,705 deaths. The average annual reported figure was 4,000,000—5,000,000 (in 1986 — 7,281,000) ARD cases, with 25—41 % of them occurring during the morbidity excess period in the first months of the year.

Throughout the observation period the seasonal character of ARD incidence was evident, morbidity being moderately raised in October-December

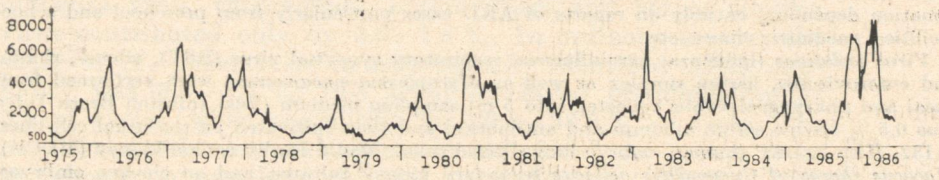


**Fig. 2.**

Incidence of notified complications (bronchitis and pneumonia) in ČSR, 1975—1986
(expressed in absolute numbers for each calendar week)

**Table 1. General characteristics of influenza seasons**

| Season | Character | Morbidity in cal. weeks | Overall duration (cal. weeks) | Dominant agent | No. of isolated influenza strains | Percentage of affected | | | | Complications |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Total population | Age group 0—5 | Age group 6—14 | Age group 15+ | |
| 1975/76 | epidemic | 7—15 | 9 | A(H3N2) | 249 | 13.4 | 32.6 | 21.2 | 9.7 | 2.9 |
| 1976/77 | epidemic | 4—12 | 9 | A(H3N2) | 242 | | | | | |
| | explosive | | | B | 28 | 16.7 | 38.1 | 30.7 | 11.8 | 2.6 |
| 1977/78 | epidemic | 4—11 | 8 | A(H1N1) | 264 | 11.6 | 28.6 | 21.8 | 7.9 | 1.4 |
| | | | | A(H3N2) | 23 | | | | | |
| 1978/79 | mixed | 6—13 | 8 | adeno | | | | | | |
| | epidemic | | | RSV | | 13.0 | 32.8 | 28.0 | 7.8 | 1.3 |
| | | | | A(H1N1) | 45 | | | | | |
| 1979/80 | two-wave | 4—17 | 14 | A(H3N2) | 230 | | | | | 1.2 |
| | epidemic | | | B | 42 | 23.8 | 60.9 | 42.4 | 15.8 | 1.8 |
| 1980/81 | epidemic | 4—12 | 9 | A(H1N1) | 87 | | | | | |
| | | | | B | 10 | 13.6 | 36.1 | 27.6 | 8.3 | 2.5 |
| | | | | A(H3N2) | 2 | | | | | |
| 1981/82 | two-wave | 4—19 | 16 | B | 27 | | | | | |
| | epidemic | | | A(H3N2) | 22 | 22.0 | 59.0 | 43.2 | 13.6 | 2.1 |
| 1982/83 | explosive | 6—13 | 8 | A(H3N2) | 343 | | | | | |
| | epidemic | | | B | 3 | 19.2 | 49.5 | 37.0 | 14.7 | 2.0 |
| 1983/84 | two-wave | 5—17 | 13 | A(H1N1) | 148 | | | | | |
| | epidemic | | | B | 27 | 22.6 | 59.8 | 41.4 | 14.6 | 1.9 |
| 1984/85 | epidemic | 4—12 | 9 | RSV | | | | | | |
| | (influenza sporadic) | | | all types | 62 | 13.4 | 34.5 | 26.3 | 8.4 | 2.7 |
| 1985/86 | mixed | 3—14 | 12 | A(H3N2) | 114 | | | | | |
| | two-wave | | | B | 57 | 30.1 | 60.5 | 64.4 | 20.5 | 2.6 |
| | epidemic | | | A(H1N1) | 1 | | | | | |

and displaying a marked excess in January-April. As a rule, the morbidity was highest among the preschool age group. However, in 1984 reported morbidity was higher among the 6—14 years group than among 0—5 years group at the epidemic peak; in 1986 morbidity in the 6—14 years group exceeded that in preschool children for a 4-week stretch and as a result total morbidity for the epidemic period was also higher in the former group amounting to 64.4 % (Table 1).

During the 11 seasons followed, there were 9 epidemics characterized by morbidity excesses; the responsible agents were predominantly type A influenza viruses. Four of the outbreaks had a clear-cut two-wave course, with type B influenza virus being involved: in 1979/80 and 1983/84 it was present together with subtype A(H1N1) and in 1981/82 and 1985/86 with subtype A(H3N2) (Table 1). These epidemics were protracted lasting 12—14

weeks and affected 22—30 % of the population. This figure was about double the affected population in the 1977—78 season (11.6 %) or the 1976—77 season (16.7 %), when the respective sole agents were A(H1N1) and A(H3N2) viruses. The most explosive influenza epidemic occurred in the spring of 1983, lasted only 8 weeks, from calendar week 6 to 13, and was caused by

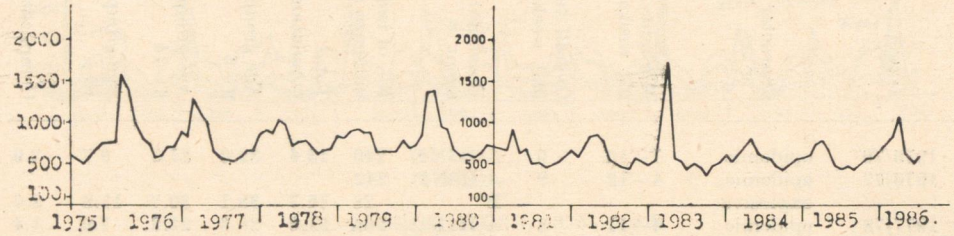


**Fig. 3.**

ARD-associated mortality from selected diseases in ČSR, 1975—1986 (absolute numbers for each month)

a drift variant A/Philippines 2/82(H3N2). This outbreak affected 19.2 % of the population and was accompanied by high excesses of complications and deaths.

Exceptional — both epidemiologically and etiologically — were the epidemics of 1979 and 1985. Although in either case the morbidity rise occurred between the calendar weeks 4 and 13, i.e. at the usual time for influenza outbreaks, and in 1979 the outbreak was explosive, the share of influenza in the morbidity was minimal. Responsible for both epidemics, which exhibited attack rates of 32.8 % and 34.5 % among preschool children, 28.8 % and 26.3 % among school children, and only 7.8 % and 8.4 % among adults, was largely RSV; in 1979 also adenoviruses (Table 1). The predominant adenovirus was type 5; it carried a distinct genome as compared with the usual type 5 strains in circulation to date (Brůčková *et al.*, 1980). Influenza aetiology was for the most part restricted to adult patients, in the 1985 epidemic mainly to pensioners homes and facilities for the chronically ill. A moderate excess of complications was encountered in 1985; the notified totals were 109,856 pneumonia and bronchitis cases and 6,804 deaths, with 83.11 % of the latter occurring in the age category above 65 years.

*Aetiological analysis of ARD*

The aetiology of ARD was systematically studied during 10 seasons, chiefly in Prague, in collaboration with paediatric clinics and dispensaries, a medical centre for apprentice schools, a student policlinic, several clinics of internal medicine, and the medical emergency service. A total of 5,474 cases of ARD of the upper or lower respiratory tract were examined. Viral aetiology was successfully demonstrated in 2,051 cases, i.e. 37.4 % (Table 2); the annual percentage varied from 21.4 (1979/80) to 51.0 (1977/78).

**Table 2. Share of viral aetiological agents in ARD morbidity, 1976—1986**

| Season | 1976/77 | 77/78 | 78/79 | 79/80 | 80/81 | 81/82 | 82/83 | 83/84 | 84/85 | 85/86 | Total positive | % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Influenza A | 15.9 | 14.9 | 7.3 | 23.3 | 6.8 | 4.3 | 28.6 | 16.3 | 11.6 | 14.2 | 285 | 13.8 |
| Influenza B | 17.6 | 0 | 0 | 3.8 | 1.4 | 9.0 | 0.3 | 8.1 | 3.4 | 18.3 | 116 | 5.6 |
| Influenza C | 0.8 | 1.1 | 0 | 0 | 0.2 | 0 | 0.3 | 0.5 | 0.4 | 0.4 | 8 | 0.3 |
| Parainfluenza | 18.5 | 17.9 | 4.6 | 18.4 | 9.4 | 23.3 | 12.9 | 14.9 | 15.9 | 11.1 | 292 | 14.2 |
| RSV | 12.3 | 19.7 | 14.0 | 15.5 | 5.1 | 12.9 | 11.5 | 12.7 | 21.5 | 3.1 | 247 | 12.0 |
| Adenovirus | 5.3 | 11.3 | 28.0 | 11.6 | 16.0 | 19.0 | 12.9 | 18.8 | 8.1 | 5.3 | 287 | 13.9 |
| Rhinoviruses | 1.7 | 11.9 | 18.0 | 8.9 | 3.1 | 4.7 | 6.6 | 6.6 | 13.9 | 8.0 | 162 | 7.8 |
| Enteroviruses | 4.4 | 1.1 | 2.0 | 0.9 | 0.2 | 2.5 | 2.0 | 0.5 | 0.4 | 2.2 | 31 | 1.5 |
| Herpes simplex | 9.7 | 3.5 | 6.6 | 6.7 | 4.2 | 3.0 | 7.6 | 9.6 | 6.4 | 4.0 | 121 | 5.8 |
| *Mycoplasma pneumoniae* | 1.7 | 1.1 | 0.6 | 3.8 | 38.9 | 1.2 | 0.6 | 0 | 2.1 | 20.5 | 201 | 9.8 |
| Mixed infections | 11.5 | 16.7 | 16.6 | 6.7 | 14.0 | 19.4 | 16.0 | 16.3 | 15.9 | 12.5 | 301 | 14.6 |
| Total positive | 113 | 167 | 150 | 103 | 349 | 231 | 286 | 196 | 232 | 224 | 2051 | 37.4 |
| Positive percentage | (37.7) | (51.0) | (38.5) | (21.4) | (39.2) | (44.9) | (33.9) | (35.3) | (35.3) | (38.2) | | |
| Total tested | 299 | 327 | 390 | 481 | 890 | 632 | 636 | 577 | 656 | 586 | **5474** | 100 |

**Table 3. Participation of viral agents in ARD according to months (Prague surveillance, 1976—1986).**

| Agent/Month | Sept | Oct | Nov | Dec | Jan | Feb | M | Apr | May | J | Jly | Aug | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Influenza A | 1 | 1 | 5 | 7 | 72 (27.7) | 118 (32.1) | 55 (18.7) | 17 (10.0) | 9 (13.9) | | | | 285 (13.8) |
| B | | 1 | | | 9 | 40 (10.8) | 45 (15.3) | 17 (10.0) | 4 | | | | 116 (5.6) |
| C | 1 | | 1 | 1 | | | 3 | 2 | | | | | 8 (0.3) |
| Parainfluenza | 8 | 75 (32.7) | 75 (25.3) | 31 (16.2) | 29 | 26 | 18 | 12 | 5 | 12 | | 1 | 292 (14.2) |
| RSV | 1 | 6 | 20 | 31 (16.2) | 67 (21.2) | 66 (17.9) | 43 (14.6) | 9 | 4 | | | | 247 (12.0) |
| Adenoviruses | 16 (24.2) | 35 (15.2) | 62 (20.9) | 27 (14.1) | 30 | 24 | 33 (11.2) | 29 (17.0) | 15 (22.0) | 9 | 2 | 5 | 287 (13.9) |
| Rhinoviruses | 8 | 27 (11.7) | 17 | 23 (12.0) | 9 | 14 | 26 | 24 (14.1) | 10 (14.7) | 2 | 1 | 1 | 162 (7.8) |
| Enteroviruses | 8 | 11 | 3 | 1 | 4 | | 4 | | | | | | 31 (1.5) |
| Herpes simplex | 5 | 20 | 20 | 9 | 10 | 11 | 14 | 16 | 8 (11.7) | 5 | 3 | | 121 (5.8) |
| *M. pneumoniae* | 8 (12.1) | 21 | 42 (14.1) | 26 (13.6) | 34 (10.7) | 16 | 19 | 22 (12.9) | 4 | 5 | 3 | 1 | 201 (9.8) |
| Mixed infections | 10 (15.1) | 32 (13.9) | 51 (17.2) | 35 (18.3) | 52 (16.4) | 52 (14.1) | 33 (11.2) | 22 (12.9) | 9 (13.2) | 4 | 1 | | 301 (14.6) |
| Total positive | 66 (32.6) | 229 (34.4) | 296 (37.0) | 191 (34.0) | 316 (41.6) | 367 (42.9) | 293 (39.1) | 170 (40.3) | 68 (26.3) | 37 (27.6) | 10 (19.0) | 8 (23.5) | 2051 (37.4) |
| Tested | 202 | 664 | 798 | 547 | 759 | 854 | 749 | 421 | 258 | 134 | 54 | 34 | 5474 |

percentage of positive > 10.00 is given in brackets

**Table 4. Aetiology of ARD according to age (surveillance Prague, 1980—1986, 4458 patients).**

| Agent | Age groups | | | | total positive |
|---|---|---|---|---|---|
| | 0—5 | 6—14 | 15—25 | >25 | |
| Influenza A | 82 (9.2) | 56 (14.7) | 47 (20.2) | 46 (38.0) | 231 |
| B | 23 (2.5) | 39 (10.2) | 24 (10.3) | 10 (8.2) | 96 |
| C | 4 (0.4) | 1 (0.2) | | | 5 |
| Parainfluenza | 165 (18.6) | 28 (7.3) | 29 (12.5) | 12 (9.9) | 234 |
| RSV | 148 (16.6) | 15 (3.9) | 11 (4.7) | 5 (4.1) | 179 |
| Adenoviruses | 155 (17.4) | 41 (10.7) | 18 (7.7) | 3 (2.4) | 217 |
| Rhinoviruses | 51 (5.7) | 20 (5.2) | 31 (13.3) | 11 (9.0) | 113 |
| Enteroviruses | 14 (1.5) | 5 (1.3) | 1 (0.4) | 1 (0.8) | 21 |
| Herpes simplex | 45 (5.0) | 26 (6.8) | 11 (4.7) | 12 (9.9) | 94 |
| *M. pneumoniae* | 50 (5.6) | 99 (26.0) | 35 (15.0) | 12 (9.9) | 196 |
| Mixed infect. | 150 (16.9) | 50 (13.1) | 25 (10.7) | 9 (7.4) | 234 |
| Total positive | 887 (54.7) | 380 (23.4) | 232 (14.3) | 121 (7.4) | 1620 (36.3) |

The most frequent agents detected were parainfluenza viruses (14.2 %), adenoviruses (13.9 %), type A influenza virus (13.8 %), and RSV (12.0 %). Rhinoviruses, type B influenza virus, and herpes simplex virus each accounted for only 5.6—7.8 % of the aetiologically identified ARD cases. A considerable percentage of the ARD (14.6 %) were mixed infections, with two or more agents demonstrated simultaneously. The most frequent combinations were RSV or adenovirus plus influenza, but the combination diversity even within a single outbreak was wide and no general conclusions can be drawn. *Mycoplasma pneumoniae* was also a relatively frequent finding. It comes out that although the agent is not a virus, its inclusion in the virological surveillance is well substantiated for, in five-year cycles, 1975, 1980, and 1985, the percentage of ARD cases of mycoplasmal aetiology was higher than that due to influenza or any other respiratory virus. In other years the aetiological share of *M. pneumoniae* in ARD morbidity was only 0.6—3.8 %.

An annually reccurring phenomenon (Table 3) was the slow increase in ARD incidence in September and October, i.e. at the beginning of the academic year for children and juveniles. Regularly, this first ARD wave (Fig. 1) was chiefly caused by adenoviruses, rhinoviruses, and parainfluenza viruses, whose prevalence usually culminated in November but on a limited scale continued through the season. The aetiological share of RSV increased gradually, reached a peak at the turn of the year (December-January), and showed a marked downward tendency from March on. Invariably, RSV infections preceded, and in some years were partially overlapped by influenza epidemics.

The prevalence of type A and B influenza viruses has, since 1976, shifted into the first months of the year and early spring, and with it culminated

**Table 5. Involvement of viral agents in ARD according to clinical features (Prague surveillance, 1980—1986)**

| Agent | Upper* respiratory tract | Lower** respiratory tract | Total positive |
|---|---|---|---|
| Influenza A | 167 (18.7) | 64 (8.7) | 231 |
| Influenza B | 80 (8.9) | 16 (2.2) | 96 |
| Influenza C | 3 | 2 | 5 |
| Parainfluenza | 137 (15.3) | 97 (13.3) | 234 |
| RSV | 63 (7.0) | 116 (15.9) | 170 |
| Adenoviruses | 108 (12.1) | 109 (15.0) | 217 |
| Rhinoviruses | 73 (8.2) | 40 (5.5) | 113 |
| Enteroviruses | 16 (1.8) | 5 (0.6) | 21 |
| Herpes simplex | 52 (5.8) | 42 (5.7) | 94 |
| *M. pneumoniae* | 92 (10.3) | 104 (14.3) | 196 |
| Mixed infections | 101 (11.3) | 133 (18.3) | 234 |
| Total positive (%) | 892 (55.0) | 728 (44.9) | 1620 |

diagnoses included:
* rhinitis, rhinopharyngitis, pharyngitis, tonsillitis, laryngitis
** tracheitis, laryngotracheitis, laryngotracheobronchitis, acute and spastic bronchitis, bronchopneumonia, pneumonia

a second, usually explosive wave of ARD. Type A influenza has had its greatest share up to 32.1 % in ARD morbidity in January-March; type B has been appearing about a month after type A and has been detected in 15.3 % of ARD at the most. These results confirm that type B influenza virus usually accompanies type A virus only towards the end of its prevalence.

Whereas the period of influenza virus predominance ends by the middle of May, parainfluenza viruses, adenoviruses, rhinoviruses, herpes simplex viruses, and *M. pneumoniae* continue to occur though on a limited scale.

Age-specific analysis (Table 4) shows that the most frequent ARD agents in preschool children over the last 7 years were parainfluenza, adenoviruses, and RSV; their joint contribution to the overall ARD attack rate in the age group was 52.7 %. The agents individually contributing the most to ARD morbidity among school children were influenza type A and B and adenoviruses. Preschool and school children displayed a high percentage of mixed infections (16.9 and 13.1 %, respectively); school children and adolescents, of mycoplasmal infections (15.0 and 26.0 %, respectively); adolescents, of infections caused by type A and B influenza viruses, rhinoviruses, and parainfluenza viruses. Type A influenza was the most frequent ARD in adults (38.0 %); its participation in ARD morbidity was lowest among preschool children (9.2 %).

The clinical picture of ARD caused by the respiratory agents concerned varied considerably and comprised affections of both the upper and lower

respiratory tract (Table 5). Matching clinical diagnosis with virological identification showed that both types of influenza virus and the rhinoviruses were predominantly involved in upper respiratory tract diseases, whereas RSV and *M. pneumoniae* were more frequent in lower respiratory tract cases, RSV even being twice as frequent in them as in upper respiratory tract affections. Adenoviruses and parainfluenza viruses were roughly evenly distributed between upper and lower respiratory tract involvements. The type of affection of the respiratory tract by a particular species of virus was highly age-related. Most of the RSV infections in the youngest children were classified as spastic bronchitis, bronchiolitis, or bronchopneumonia; type A influenza virus was one of the causes of severe pneumonia in patients above 60.

Similarly as the types and subtypes of influenza virus varied from season to season, so did the prevalence of individual types of parainfluenza, adenoviruses, and rhinoviruses.

The most frequent among the 161 parainfluenza isolates were types 1 and 3, which were found every year during 1979-86. In all, 50 cases were shown to be caused by type 1 and 86 by type 3. Type 2 was not detected during the 80/81 and 82/83 seasons and was found only once in the 84/85 season, so that the results obtained suggest 2-year cycles for its occurrence.

Among the 176 adenoviruses, the most frequent were type 3 (57 cases, highest prevalence in 1981/82 and 1983/84), type 2 (46 cases, highest prevalence in 1980/81, 1982/83, and 1984/85), and type 7 (36 cases, highest prevalence during 1981-83). Type 1 was isolated from 23 ARD cases during 1980-86, and types 4, 5, and 6 from 1—4 ARD cases in different years.

The most frequent type among the 114 rhinoviruses identified was 13, with 25 isolations, most of them in 1984-1986, followed by type 22 (10 isolations, 1981/82, 1984/85, 1985/86) and type 2 (12 isolations, 11 of them in the 1979/80 season). Of the others, rhinovirus types, 12, 15, 35, 49, 1A, 1B, 16, 4, and 41, were each isolated from less than 9 cases during two or three seasons and types 6, 8, 9, 21, 24, 29, 32, 51, and 59 were isolated only sporadically.

In terms of type and time distribution, the incidence of rhinoviruses seemed quite random, and the times and numbers of isolations do not allow inference about the prevalence or cyclicity of certain types. Only types 2 and 19 were shown to have caused local ARD outbreaks among prematurely born babies and young sucklings in 1978 and 1980 (Vocel *et al.*, 1980).

## *Discussion*

In evaluating the character of the 11 seasons followed, one can say that all of them displayed a similar course of morbidity during the early and the late period (September-December and April-June). The early period was characterized by enhanced prevalence of adenoviruses, rhinoviruses, and parainfluenza viruses. Transient decline in morbidity was encountered annually at the turn of the year. Morbidity excesses were invariably more clear-cut

at the times of advent of a new subtype-A(H3N2) drift variant, a phenomenon also observed by Frank *et al.* (1985) in 1977—81. Subtype A(H1N1) was not accompanied by any spectacular excess even in 1979 when it reappeared after 30 years of absence and the age groups below 26 lacked antibodies. Morbidity excesses elicited by other viruses were not usual, but, as the 1978/79 and 1984/85 seasons showed, they could appear occasionally. At this point it is important to emphasize the significance of a concomittantly performed virological surveillance, which in our study allowed recognition of some unexpected aetiologies: the explosive epidemic of 1978/79 caused by adenoviruses and RSV could, without the virological information, be considered a classical attack of influenza.

Excesses of pneumonia and bronchitis were also more pronounced in association with influenza A(H3N2) than A(H1N1) epidemics. Apart from influenza, outbreaks caused by *M. pneumoniae* in 1975/76, 1980/81, and 1985 were also followed by excesses of complications. Epidemics due to this agent recur at characteristic 5-year intervals, as established by many authors both abroad and in Czechoslovakia (Foy *et al.*, 1979; Syrůček *et al.*, 1983).

Mortality excesses were only observed during influenza epidemics predominantly caused by new A(H3N2) drift variants; the year 1983 was an illustration of particular force. The death excess toll was highest among persons above 65 years of age and people suffering from the more usual chronic diseases. All authors concerned with this problem recommend preventive vaccination of chronics and the elderly. Recently Strassburg *et al.* (1986) presented the first optimistic results of successfully lowered mortality and morbidity, particularly in pensioners' homes and sanatoria for the chronically ill.

Long-term surveillance programme confirmed the high frequency of ARD cases among preschool children where the most frequent aetiological agents were parainfluenza viruses, adenoviruses, and RSV. In this point our results agree with those of other authors (Assad and Cockburn, 1974; Sutmoler *et al.*, 1983). An age shift, i.e. a higher morbidity among school than preschool children described by Glezen *et al.* (1984) is probably unusual; during the 11 years of ARD surveillance we only encountered it twice, both times in connection with a two-wave epidemic of type A and B influenza. Both of these viruses, together with *M. pneumoniae*, are the most frequent agents of ARD in school children and adolescents. Surprising in our material was the high percentage of mixed infections in all age groups from 0 to 25 years.

Surprising was also the low percentage of ARD cases due to type C influenza virus. An explanation can probably be found in the very mild or subclinical course of the disease, which escapes examination. In another study, based on serological testing of sera collected at random in Czechoslovakia and in the German Democratic Republic in 1981, we detected antibodies against this influenza virus type in 40—60 % of children in the 5th year of life and in 80 % of adults above 25 (Tůmová *et al.*, 1983).

Analysis of the presented results suggests certain time interrelations in the predominance of individual agents: e.g., there was a regular rise in RSV infections antecedent to the epidemics of influenza, also observed by Ane-

stadt in 1974-1981 (1982), an increase in the number of established parainfluenza infections antecedent to the enhanced RSV circulation, also reported by Glezen and Denny (1973), and quite independent circulation of adeno- and rhinoviruses throughout each season. Not quite clear is the time-distribution as well as contribution and importance of enteroviruses and the herpes simplex virus. A very explicit time — related occurrence was exhibited by type A influenza. Assaad and Cockburn (1974) having analysed morbidity in 11 European countries in 1967—1973, state December-March as its time span; in our material the interval was January-May; but in mutual agreement, type B prevalence has been observed to set in about 1 month after the start of type A. Solitary cases of influenza could be encountered up to 2 months ahead of an outbreak, the virus isolate being antigenically identical with the strain inducing the epidemic. We did not manage to detect virus in the summer months after an epidemic, nor did we observe in influenza epidemics the phenomenon called by Glezen *et al.* (1982) a "herald wave".

The present aetiological study of ARD has above all portrayed their aetiological diversity: nevertheless, there still remained ± 60 % of ARD cases which did not have their agent identified. Although the 37.5 % identified aetiologies correspond to the usual average, an extension of the spectrum of ARD agents by including other viruses and bacteria is desirable. It would doubtless also be useful to enhance ARD prevalence studies by incorporating factors of the changing environment and climatic conditions. However, the task of primary importance for the benefit of routine clinical practice, causal therapy, and operative application of antiepidemic measures is to accelerate the laboratory diagnosis of the diseases.

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